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Organic Geochemistry of Pennsylvanian-Permian Oils and Black Shales, Northern Denver Basin

We performed organic geochemical analyses of Paleozoic shales and oils from the northern Denver basin to determine oil-source bed relationships. We recognized two general oil types: oil produced from reservoirs of Virgilian and Wolfcampian age in northeastern Colorado and Nebraska, and oil produced form the Lower Permian Lyons Sandstone near the basin axis in Colorado. Low-gravity oil (20° API) produced from the Virgilian-age reservoir at the Amazon field (Nebraska) and a higher gravity oil (37° API) produced from a well near the Amazon field (Wexpro 1-23 Lyngholm) can be distinguished geochemically from the other Virgilian-Wolfcampian oils studied and may be genetically unrelated to them. For comparison, we analyzed oils from the Minnelusa Formation (Permian-Pennsylvanian) in the Powder River basin. These oils are geochemically unlike any Paleozoic oils analyzed in this study in southeastern Wyoming and Colorado.

We evaluated shale samples of Desmoinesian, Wolfcampian, and Leonardian age for source rock potential. Shales of Leonardian and Wolfcampian age in southwestern Nebraska contain as much as 6% organic carbon and 4,000-7,000 ppm extractable hydrocarbons. However, the Wolfcampian samples analyzed contain hydrocarbons that are enriched in carbon-13 by 3-5 per mil compared to nearby oil occurrences and are, therefore, improbable source rocks for current oil discoveries. Hydrocarbons extracted from one sample of Leonardian shale are isotopically similar to the Virgilian-Wolfcampian oils. Thermally mature shales of Desmoinesian age in northwestern Nebraska containing as much as 18% organic carbon and about 800-8,000 ppm hydrocarbons are considered excellent potential source rocks.

CLEMENT, MARK A., Independent, Dallas, TX

Oil and Gas Economic Analysis with VisiCalc

Recent expansion in microcomputer user memory offers the petroleum industry the opportunity to use the VisiCalc (spreadsheet) program for economic analysis of potential oil and gas production.

The program presented requires a microcomputer with a minimum main memory capacity of 128K. The program consists of four sections: (1) input data; (2) pre-tax cash flow and present net worth, both discounted and undiscounted; (3) after-tax cash flow and present net worth, both discounted and undiscounted; and (4) sensitivity analysis illustrating present net worth and return on investment before and after tax using varying discount rates.

Data is entered and calculations are displayed on an annual basis. The project's economic limit is calculated using the input data. The program contains a provision for project abandonment contingent on any negative cash flow development resulting from operating costs after the third year. Once the basic program is entered, the impact of data variations on present net worth of the project may be obtained in a matter of seconds.

An enlarged program, requiring a 256K capacity, necessitates input and display on a monthly basis, recognizes "payout," and adjusts working interest costs and net revenues accordingly.

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Culmination Collapse in Fanjah Saddle, Oman

Culmination collapse structures in the central Oman Mountains have overprinted and clouded the surface expression of deep-seated regional structures, as typified by the Fanjah Saddle. The saddle forms a domain of low structural relief situated along the trend of a series of major structural culminations. It is bounded on the east and west by the plunging noses of the parautochthonous Mesozoic shelf carbonates of the Saih Hatat and Jabal Nakhl culminations, respectively, and contains a stack of Late Cretaceous basinal and ophiolitic thrust sheets.

Culmination collapse, initiated by backslip movement of the dense overlying nappes, has resulted in a saddle geometry containing both extensional and compressional regimes. Listric normal faults in the culminations converge toward the saddle and serve as feeder zones to the saddle core which acts as a sink for the thrust sheets. Smaller surge zones with extensional trailing edges and compressional fronts defined by recumbent folds radiate outward from the culminations. This has been superimposed over earlier isoclinal folding produced by the emplacement of the overlying nappes. The final result is a complex internal geometry and distribution pattern of structures. Distinguishing these shallow deformational events from deep seated structural styles is essential for the correct extrapolation of surface data to the subsurface in any exploration program.

COLE, W. F., McClelland Engineers, Inc., Ventura, CA, D. G. KERSEY, Core Laboratories, Inc., Dallas, TX, and C. C. MATHEWSON, Texas A&M Univ., College Station, TX

Environment of Deposition of an Eocene Lignite-Bearing Sedimentary Sequence in Northeast Rusk County, Texas

The stratigraphy and environment of deposition of the undivided Wilcox Group (lower Eocene) and Carrizo Formation (Eocene) were studied in an 88 km^2 (34 mi^2) area in northeastern Rusk County, Texas. Seven cores and 300 borehole logs were used in the study. The undivided Wilcox Group is the predominant geologic unit in the study area and consists of poorly lithified, interlaminated sandstones, siltstones, claystones, and lignite seams. Lignite seams range in thickness from 0.1 to 2.2 m (4 in. to 7 ft) and are conformable with the overlying and underlying strata. Subtle coarsening-upward sequences, 1.8-31.3 m (6-103 ft) thick, occur between lignite seams; however, the individual sandstone units, 0.3-1.8 m (4 in.-6 ft) thick, within these sequences fine upward. The fine-grained rocks of the Wilcox Group are overlain unconformably by well-sorted, medium to coarse-grained sandstones of the Carrizo Formation. The small-scale sedimentary structures, fine-grain size, and matrix-rich nature of the undivided Wilcox units are characteristic of fluvial overbank deposits. Peat beds probably accumulated in interchannel swamps on a lower alluvial plain, distal from overbank discharge. As streams meandered across the area, overbank discharge buried the swamps. The coarsening-upward sequences between lignite seams indicate overbank deposition from a prograding stream. Swamps were reestablished as the stream was abandoned or migrated away. Fining-upward trends in grain size and the upward decrease in scale of sedimentary structures indicate the Carrizo Formation was deposited in fluvial channels.

COLEMAN, J. M., Louisiana State Univ., Baton Rouge, LA, A. H. BOUMA, Gulf Research and Development Co., Houston, TX, and LEG 96 SCIENTIFIC PARTY

Stratigraphy, Depositional Rates, and Other DSDP Leg 96 Conclusions: Mississippi Fan

The Quaternary Mississippi fan consists of at least seven seismically mappable fan lobes. Eight sites were drilled into the youngest fan lobe during DSDP Leg 96. The Holocene (Ericson Zone Z) is capped by a marly foraminiferal ooze. Assuming an age of 12,000 yr for the Holocene/Pleistocene boundary, a minimum accumulation rate of 3-30 cm/1,000 yr (1-12 in./1,000 yr) is computed for the Holocene.

The youngest fan lobe was deposited during the upper part of Ericson Zone Y (late Wisconsin glacial, 12,000-85,000 y.B.P.). Deposition rates for the Y Zone are extremely high for the middle fan sites, averaging 12 m/1,000 yr (39 ft/1,000 yr). Lower fan accumulation rates are 7 m/1,000 yr (23 ft/1,000 yr) for the channel sites and 6 m/1,000 yr (20 ft/1,000 yr) for the channel-mouth depositional lobes. These rates are not corrected for compaction.

Foraminifera are scarce; the occurrence of shallow-water benthic species indicates a displaced inner and middle neritic origin for the sediments.

Drilling on the youngest fan lobe shows that most of the silts and sands were transported through the upper and middle fan channel onto the lower fan, producing a 6 to 10-km (4 to 6-mi) wide, 135-m (443-ft) thick aggradational channel deposit. Much of the fine-grained sediment spilled out of the channel onto the adjacent overbank areas, constructing a broad marginal plain. The channels on the lower fan are smaller and shift position frequently. Channel-mouth depositional lobes are constructed at the end of the active channels and are composed of more than 50% net sand.